IN THE APPLICATION

OF

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FOR

ELECTRIC MOTOR WINDINGS

RELATED FOREIGN APPLICATION

[0001] The present application claims the benefit of previously filed co-pending French Patent Application Number 0207820000 filed June 25, 2002.

FIELD OF THE INVENTION

[0002] The present invention relates to a high efficiency, low input alternating current electric motor, high output synchronous generator and of varied size and varied speed, and to a specific method of construction.

BACKGROUND OF THE INVENTION

[0003] It is generally known for single phase alternating current electric motors to be used from a relatively small size, from fractional horse power up to approximately ten horsepower and thereafter three phase motors are generally used up to very large applications.

[0004] In U.S. Patent Number 4,446,416A to Cravens L. Wanlass, granted May 1, 1984, entitled "Polyphase Electric Machine Having Controlled Magnetic Flux Density" being either a motor or a generator, there is provided a stator core having main windings and additional control windings. The flux density is optimized in a polyphase machine by controlling the flux density in the stator core.

[0005] A main polyphase stator winding is wound on a magnetic core, the winding comprising a plurality of windings and each winding represents a single phase. Capacitors are connected with each of the windings in a series circuit.

[0006] The present invention is quite distinct and clearly stated in the description.

[0007] An additional motor winding technique is also known from the specification of German Patent Application No. 2508374 with a publication date of 09-09-1976 and titled "Single Phase Induction Motor" to Wen, Hung-Ying. This patent application discloses only an induction of a single phase motor with two start windings so as to increase the start capacitor voltage. It also establishes a single phase induction motor with two sets of start windings, with better running power factor and improved starting torque.

SUMMARY OF THE INVENTION

[0008] The present invention relates to an alternating current electric machine, and in particular, an alternating current electric motor, which could be a single phase electric motor or a multiphase electric motor with at least three phases including a synchronous generator with two poles or more. The electric motor including main windings and de-saturation of additional windings in which each additional winding being fed through at least one or multiple capacitors. Then each additional winding is fed through one or multiple capacitors in opposite phase angles and opposite field directions from each respective main windings. The electric motor is specifically distinguished and one of the inventive features is clearly distinct in the total cross section of the wire used on each main and additional winding, and follows a distinct respective ratio of predetermined value. This ratio may be approximately 2/3 for the main winding and 1/3 for the additional winding.

[0009] The invention in a preferred form includes a winding process for the alternating current electric motor, in that the two windings of said electric motor being built at one time in one only operation, as a single step.

[0010] Conveniently, the present invention includes a process for the calculation of an additional winding capacitor, with a formula in which the capacitor value in Micro Farads is directly proportional of the actual full load currently in a process consumed by the electric motor or by the synchronous generator, reverse proportional of the square of the line voltage and affected by a multiplying factor within a range of between 0.25×10^6 and 0.3×10^6.

[0011] Advantageously, a single phase electric motor, according to the present invention, would comprise first and second main windings coupled to a main common point and first and second main potential lines of a line voltage, and first and second additional windings coupled to a winding capacitor and the first and second potential lines in a parallel connection with the first and second main windings. The first and the second additional windings generating a field in opposite direction with a corresponding one of the first and second main windings.

[0012] Suitably, a start winding is coupled between one of the first and second potential lines and a start capacitor, with a switch coupled between the start capacitor and one of the first and second potential lines.

[0013] A distinct advantage is that each first and second main winding has a main wire size and each of the first and second windings has an additional wire size in which the main wire size is about twice the additional wire size.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The invention will now be described, by way of example only, with reference to the accompanying drawings in which:

[0015] FIG. 1 depicts a known single phase electric motor;

[0016] FIG. 2 depicts a known three phase delta configuration motor;

[0017] FIG. 3 shows a known three phase delta configuration electric motor;

[0018] FIG. 4 shows a modified known single phase electric motor;

[0019] FIG. 5 depicts a modified known delta configuration of an electric motor;

[0020] FIG. 6 shows a modified known star configuration of an electric motor;

[0021] Figure 7 shows known winding interval connections of electric motors;

[0022] Figure 8 depicts, according to the present invention, a single phase electric motor;

[0023] Figure 9 shows, according to the present invention, a three phase electric motor on a delta configuration;

[0024] Figure 10 shows, according to the present invention, on a star configuration a three phase electric motor; and

[0025] Figure 11, according to the present invention, shows winding interval connections of a four poles on delta adjacent poles, three phase electric motor.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] In the present invention, the electric motor technology background of known designs is established in Figures 1 through 7.

[0027] Figure 1 shows a known single phase motor with a run winding (1), a start winding (2), and a run capacitor (3).

[0028] Like reference numerals in the different known designs of Figures 1 through 7, as well as those depicted in the inventive features of Figures 8 through 11 are used to provide a comparative study between known features and those inventive steps, according to the present invention.

[0029] In Figure 1, the known technology explains the limited efficiency by the saturation level of the wire size that is used for the electric motor construction.

[0030] Figures 2 and 3 show the conventional three phase motor and the windings are indicated by the reference numbers (1), (2), and (3), with the incoming line voltage of the three phase are indicated as (R), (S), and (T) with the center point of the star connection as (O).

[0031] In known three phase electric motors, the construction uses a specific number of poles, on the basis of required speed, and the star or delta configuration internally connected as required for the purpose of torque, horsepower and voltage.

[0032] In both single phase and three phase electric motors, heat losses affected by temperature losses are generally moderated by different standards of commonly available insulation.

[0033] It is also known to provide improvements in single phase electric motors, by providing a start capacitor in series with a centrifugal switch or a disconnecting relay when added to the start winding circuit. An accurate calculation of the run capacitor sizes in Micro Farads optimizes the efficiency of the electric motor enhancing starting torque, starting current and running temperatures.

[0034] Figure 4 is a further design of a single phase electric motor, in which are shown the run winding (1), the start winding (2), the start capacitor (3), the centrifugal switch or disconnecting relay (4) and the run capacitor (5).

[0035] Figure 5 shows a three phase electric motor, an additional winding provided and fed through capacitors and parallel connected to the main winding. This figure illustrates a delta configuration. The three main windings are (1), (2), and (3), and the three additional windings are (4), (5), and (6). The additional winding capacitors are (7), (8), and (9), and the three phase line voltage connections are (R), (S), and (T).

[0036] Figure 6 illustrates a star configuration, with the three main windings (1), (2), and (3), and the three additional windings (4), (5), and (6). The additional winding capacitors (7), (8),

and (9), the three phases line voltage connections (R), (S), and (T), and the center point of the stars are for the main winding (OP) and for the additional winding (OS).

[0037] Figure 7 depicts winding interval connections and shows a four poles one delta adjacent poles, three phase winding and the internal connections of the main and additional windings.

[0038] The connection point for the in line (R) is marked (4) for the main winding and (7) for the additional winding. The in line (S) is marked (6) for the main winding and (8) for the additional winding. The in line (T) is marked (5) for the main winding and (9) for the additional winding. The additional winding capacitors are marked (1), (2), and (3). Observing the respective delta connection on each main and additional winding, there is a physical unbalanced pattern. Delta connection (6) is totally uneven in relation with delta connections (4) and (5).

[0039] Delta connection (8) is totally uneven in relation with delta connection (7) and (9). This physical unbalance affects phase angle slip between the two windings in relation to the rotation direction (clockwise or counterclockwise) of the rotor. This type of winding internal connection affects energy savings in one rotation direction.

[0040] Processing the above technology on a conventional three phase electric motor achieves the following:

[0041] Increase of overall copper density by about 15%;

[0042] Separation of the conventional winding into two separate windings following the ratio of ½.

[0043] Conversion of the conventional winding into a lap layout adjacent poles connected (Consequent poles type windings cannot be used);

[0044] Conversion of the conventional winding connections into a delta configuration respecting the original number of circuits;

[0045] Calculation of the additional winding capacitor rating in Micro Farads;

[0046] Formula: $$C = P \times \frac{(460)^2}{(E)^2} \times 1.5$$

[0047] **C** is the capacitor value in Micro Farads per phase;

[0048] **P** is the electric motor theoretical rated horse power;

[0049] **1.5** is a multiplying factor derived from the research experiments;

[0050] **460** is a constant base voltage.

[0051] This formula does not allow us to accurately calculate the optimum capacitor value, not taking in consideration the actual field working under load parameters of the motor. So even though these types of electric motors runs at a better power factor and does save some energy, they are a lesser quality product, with a shorter life term, and they can be improved.

[0052] Figure 8 depicts, according to the present invention, a single phase electric motor. The main winding is shown in two half sections (1a) and (1b) separated by a middle point (O). The additional winding also shows two half sections (5a) and (5b) separated by a capacitor (6). The start winding (2), the start capacitor (3), and the centrifugal switch or the disconnecting relay (4) are also shown. The single phase electric motor, according to the present invention, depicts an additional winding that is parallel connected with the main winding. Each of the half sections are in opposite field directions with each other and connected at the center point to a capacitor. The center point of the main winding is used for dual voltage purpose.

[0053] Figure 9 shows a three phase electric motor, according to the present invention, on a delta configuration. The main windings are (1), (2), and (3), the additional windings are (4), (5), and (6), the additional winding capacitors are (7), (8), and (9). The delta connection points of the three main windings are (R), (S), and (T). It should be noted that according to the present invention, that the incoming line voltage connection points are (Ra), (Sa), and (Ta). Each additional winding is fed from a different phase than its respective main winding, which puts it on an opposite field situation, with a predetermined capacitor value that allows it to feed this winding.

[0054] Figure 10 depicts a three phase electric motor, according to the present invention, in a star configuration. The three main windings (1), (2), and (3), the three additional windings (4), (5), and (6), and the additional winding capacitors (7), (8), and (9) with the star connection point (O), and the three line voltage connections (R), (S), and (T).

[0055] Each additional winding is fed with a different phase than its respective main winding. The de-saturation additional winding (4) of main winding (1) is connected through capacitor (7) to in line (5) of main winding (2). De-saturation additional winding (5) of main winding (7) is connected through capacitor (8) to in line (T) of main winding (3).

[0056] De-saturation additional winding (6) of main winding (3) is connected through capacitor (9) to in line (R) of main winding (1). This clearly shows the opposite field position of the different winding. It should be noted, that according to the present invention, we have a single star connection point.

[0057] Figure 11 illustrates winding internal connections of a four poles one delta adjacent poles, according to the present invention, for a three phase electric motor. The connection point for the in line (R) being point (4) for the main winding and point (7) for the additional winding. The connection point (6) is for the in line T, and the connector point (8) is for the additional winding. The additional winding capacitors being (1), (2), and (3).

[0058] It should be noted that the respective delta connections of each main and additional windings are three delta points (4), (5), and (6) of the main winding are perfectly symmetrical and equidistant from each other. This novel configuration totally corrects the efficiency and energy saving problem in relation to the direction of rotation. This inventive illustration provides a four poles one circuit delta, which corrects the rotational problem at other speeds and multiple number of circuits, in either a delta configuration or a star configuration.

[0059] Thus, to convert a known single phase or three phase electric motor, as defined in the present invention, the following advantages are noted:

[0060] No changes on the copper density;

[0061] Separation of the conventional winding in two different and separate winding following the approximate ration of 1/3, and 2/3;

[0062] No changes are required on the original type of winding layout, adjacent or consequent poles.

[0063] Both windings, according to the present invention, can be wound and inserted at once in only one operation in a single step. It is feasible to calculate the value of the additional winding capacitor in Micro Farad per phase. This value is directly proportional to the real full load current in Amperes per phase. Reverse proportional of the square of the line voltage in volts. The value timing is then determined by a multiplying factor that is approximately between 0.25×10^6 and 0.3×10^6. The novel interconnections of the two are in opposite field directions and on different phases from each other.

[0064] It is, therefore, clearly advantageous according to the present invention, to increase the overall efficiency, a distinct improvement of the power factor, a noted considerable drop in the starting current, running current and in the full load current.

[0065] Conveniently, each additional winding is fed through one or more multiple capacitors in opposite phase angle and opposite field directions from each respective main windings and in which the total cross-section of the wire size used on each main and additional winding are of predetermined dimensions.

[0066] Suitably, the calculation process of the winding capacitor value follows a specific formula in which the capacitive value in Micro Farads is directly proportional to the actual full load current in Amperes consumed by the electric motor, or produced by the synchronous

generator, reverse proportional to the square of the line voltage and affected by a multiplying factor that is approximately between 0.25×10^6 and 0.3×10^6.

[0067] It will be appreciated that in a single phase electric motor characterized in that first and second main windings coupled to a main common point and first and second potential lines of a line voltage, first and second additional windings coupled to a winding capacitor and the first and second potential lines in a parallel connection with the first and second main windings, each of the first and second additional windings generating a field in opposite direction with a corresponding one of the first and second main winding.

[0068] Preferably, the first and the second main windings has a main wire size and each of the first and the second additional windings has an additional wire size, in which the main wire size is approximately twice the additional wire size.

[0069] In a convenient form, a multi-phase electric motor comprises a plurality of main windings connected in delta configuration at three line connection points having a line voltage, each of the main winding having a main wire size, and a plurality of segments connected in parallel with the plurality of the main winding. Each segment including an additional winding and a winding capacitor, with the additional winding having an additional wire size and a phase different than and generating a field in opposite direction with a corresponding one of the main windings.